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Title: A Study of the Early Detection of Insect Infestations and  
Density/Distribution of Host Plants.

Citrus Insects Research  
USDA, ARS  
509 West Fourth St., Weslaco, Texas 78596

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- (a) During this period, we have received Skylab data in form of 70 mm photography. We received no S190B (earth terrain camera) imagery which was our number 1 priority. The 70 mm provides significant data considering the scale but for maximum utilization of the data in our program it is necessary to receive the larger, higher resolution format. We are making studies of the film with photographic density slicing techniques, and color additive methods, hoping to improve the interpretation capability. The S190A data has provided significant information on areas of vegetation on both sides of the Rio Grande River in the citrus producing area of Texas. The physical features of the area such as drainage patterns, water courses and some soil characteristics are apparent on the black and white and aerial color films. The patterns of vegetation become very clear with the color infrared film. Despite reduced resolution much more information about the distribution of vegetation on both sides of the border is evident with the color IR film. This photography clearly delineates the possible avenues of entry of pest insects from Mexico into the United States and the United States into Mexico. This information can be used to designate possible areas of stress where increased vigilance in surveillance procedures would be required on both sides of the border. The areas of little vegetation, and subsequently less stress, are also clearly evident. While this is preliminary data at the present time it could prove highly significant in planning surveillance, regulatory and control programs designed to prevent movement of damaging pests from one area to another. This technique could of course be greatly improved by identification

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of host plants either by enhancement of the photography with photointerpretation techniques or by the use of cameras with greater resolution such as the S190B. We are continuing to make flights and collect ground truth data of insect infestations and host plant relationships. Flights were made to the pecan producing region of Texas near Seguin to determine if remote sensing is feasible for detecting damage of the walnut caterpillar that has caused tremendous defoliation of many thousands of pecan trees in that area. The photographs were excellent, and NASA was contacted to obtain data from Skylab. Our opinion is that it should be readily detectable from space since large acreages of pecan trees are affected and the influence on reflectance characteristics is pronounced.

- (b) We must receive data from the S190B (earth terrain camera) to really make the program a complete success. We have significant data from ground surveys and our aerial photography is yielding impressive results but we need good quality, high resolution, S190B data.
- (c) Our next reporting period is during a time where signatures resulting from insect infestations are providing good contrast on the aerial film. We expect our aircraft data to show this increase, and we hope that the S190B data will also provide this information. We also hope to add significant information on vegetation patterns by using density slicing and color additive methods on the S190A film.
- (d) The most significant results we have obtained to date is the identification of areas of vegetation and absence of vegetation along the border. Prevention of the entry of new pests to an area is of great importance because the pest usually arrives without any of its natural enemies. This usually results in a rapid explosion of the population of the pest and severe damage to host plants in the area of introduction. If the avenues of entry and areas of stress can be determined with Skylab data this should prove immeasurably useful in planning surveillance programs and perhaps eradication campaigns when introductions do occur. The S190A shows vegetation patterns quite well but because of poor definition when the film is enlarged there is little chance to identify hosts such as citrus. Hopefully this can be overcome by the use of S190B data, by the application of color enhancement techniques with other S190A film or by sequential observation of cropping patterns with subsequent data. The latter procedure may enable us to differentiate permanent cropping (i.e. citrus) from annual cropping and also vegetation that retains its green color throughout the seasonal cycle. All of these factors could lead to more effective methods of

determining host plant distribution and avenues of entry for pest species. This could greatly reduce the cost of time consuming and expensive ground surveys. For detection of insect damage we feel that scientists will need a camera with a longer focal length and larger format than the 6 inch, 70 mm multi-spectral package. The S190B may provide the required data for this purpose.

- (e) It appears that valuable information can be developed about patterns of vegetation and host crops in the test area. The development of this type of information should be transposable to other crops and pest problems in other areas. By the use of additional photointerpretation techniques and other systems this procedure could be refined to provide much more detailed information on hosts of a variety of pests in critical areas. We also anticipate that the S190B will give us meaningful information so that we can truthfully say that insect infestations of various crops can be detected from a spacecraft.
- (f) Travel noted during this period was for 2 flights to central Texas on the walnut caterpillar program, and for local travel in connection with ground truth collection and local flights.